United States Environmental Protection Agency **Office of Research and Development**

National Exposure Research Laboratory
Research Abstract

Government Performance Results Act (GPRA) Goal 2
Annual Performance Measure 71

Significant Research Findings:

Report on the Biological Condition of Mid-Atlantic Shallow Streams and Deep Rivers Based on Macroinvertebrates as a Basis for Management Action

Scientific Problem and Policy Issues

In 1995, the U.S. Environmental Protection Agency's (EPA) Office of Research and Development (ORD) formed a partnership with the EPA Region 3 Office to implement a research, monitoring, and assessment project in the Mid-Atlantic Region of the U.S. This project was the Mid-Atlantic Integrated Assessment (MAIA) and included forests, estuaries, and streams. The MAIA's mission was to inject scientific knowledge into the decision-making process for the Mid-Atlantic Region of the U.S. In 1997 and 1998, a probabilistic assessment of shallow streams and deep rivers in the region was conducted and included collection of fish, macroinvertebrates, and algae indicators. These data can provide a baseline from which states and the region can monitor streams and deep rivers.

Research Approach

This study focused on evaluating the macroinvertebrate data for shallow streams and deep rivers from the MAIA study for the purposes of assessing condition and identifying macroinvertebrate indicators appropriate for each type of water body. Macroinvertebrates are commonly used as indicators of condition in streams because they have a relatively long lifespan compared to algae but are less mobile than fish. For a portion of shallow streams, an existing multimetric macroinvertebrate biotic integrity index (MBII) and the probabilistic design were used to assess biological condition directly. In addition, a nonparametric risk analysis was conducted using shallow stream data from the entire mid-Atlantic region. This analysis identified abiotic factors that influence index scores, as well as values of the individual metrics that comprise the MBII. For the much smaller set of sites on deep rivers, there is no existing macroinvertebrate indicator available. Instead, individual metrics were evaluated for the ability to reflect impacts from various potential stressors at these sites.

Results and Impact

The application of the MBII to shallow streams data from 1997 and 1998 in the mid-Atlantic highlands part of the region estimated that approximately 19% (66,215 km) of streams in that region are in good condition, 25% (86,374 km) are in poor condition, and the rest (189,521 km) are in fair condition. The largest proportion of sites in good condition and the smallest proportion of sites in poor

condition was found in the Northern Appalachians ecoregion. A relatively large proportion of sites in Poor condition were found in the Piedmont, Valley, and Western Appalachians ecoregions. Very small proportions of sites in Good condition were found in the Valley and Central Appalachians ecoregions.

The risk analysis indicated that in-stream habitat was very influential to the overall MBII score, but each component metric responded to a different set of abiotic variables. It also showed that, in general, when only a few potential abiotic risk factors were present at a site, the effect on macroinvertebrates tended to be small, but risk of a negative biological impact increased rapidly at intermediate numbers of risk factors.

Analysis of metrics for the deep rivers data showed that only a small number of metrics correlate with physical habitat or water chemistry measures. Taxa richness of chironomids and percent of individuals in the dominant five taxa were correlated with several habitat variables, and percent of individuals as collector-gatherers and intolerant taxa richness were correlated with several water chemistry variables. Several macroinvertebrate metrics tested were related to mean substrate size and may serve as potential indicators of sedimentation. Further testing of these metrics is warranted to determine the extent of their utility outside of the Mid-Atlantic region.

This project supports ORD's research to improve the quality of the nation's waters under the Government Performance and Results Act (GPRA) Goal 2 Clean and Safe Water. The report of this research (Annual Performance Measure (APM) 71) provides water resource managers with an illustration of the use of bioindicators to assess condition and to identify potential stressors that may be targeted for management action at the state and regional level. It illustrates the necessity to consider the water body type, shallow streams versus deep rivers, when selecting the indicators for assessment. As stated above, a new tool, a nonparametric risk analysis, was applied to the shallow stream data in this research project. Results of the nonparametric risk analysis identified potential stressors to the macroinvertebrate communities of mid-Atlantic shallow streams.

Research Collaboration and Research Products	Technical lead for development of this report was National Exposure Research Laboratory (NERL) Ecological Exposure Research Division (EERD) staff scientists. The design of the MAIA study on streams and rivers was a collaborative effort between NERL and National Health and Environmental Effects Research Laboratory NHEERL staff scientists. Sample collection and processing were conducted through contractor support by SoBran, Inc. Analysis of the data was conducted by NERL/EERD staff scientists, with contractor assistance by SoBran, Inc.
Future Research	This report will be provided to stakeholders in the Mid-Atlantic region for further review and refinement to increase its utility as a management tool. The work described here is part of the larger MAIA project, which is, in turn, a part of the larger Environmental Monitoring and Assessment Program (EMAP). This program is working to assess status and trends in waters across the U.S.

Contacts for Additional Information

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